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Engineering Design File 2648

PROJECT FILE NO. 020996

Staging, Storage, Sizing and Treatment Facility

Process Systems Drain Pipe Sizing

U.S. Department of Energy
Idaho Operations Office
Idaho Falls, Idaho

INEEL
Idaho National Engineering & Environmental Laboratory
BECHTEL BWXT IDAHO, LLC

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ENGINEERING DESIGN FILE

Project File No. 020996
EDF Serial No. EDF-2648
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PROJECT/TASK Staging, Storage, Sizing and Treatment Facility (SSSTF)

SUBTASK **SSSTF Fire and Decontamination Water Disposal System**

TITLE: **Decontamination Building - Process Systems - Drain Pipe Sizing**

SUMMARY: The National Fire Protection Association (NFPA) in NFPA 801 (Standard for Fire Protection for Facilities Handling Radioactive Materials) requires that discharged firewater from a facility processing radioactive material be contained. The applicable requirements for drainage design are found in NFPA 801 Section 3-10.2 for this specific facility. The provision in this section are:

(a) The spill of the largest single container of any flammable or combustible liquid in the area.
(b) The credible volume of discharge (as determined by the fire hazards analysis) for the suppression system operating for a period of 30 minutes where automatic suppression is provided throughout.
(c) The volume based on a manual fire-fighting flow rate of 500 gpm for a duration of 30 minutes where automatic suppressions is not provided throughout, unless the fire hazards. Analysis demonstrates a different flow rate and duration.
(d) The contents of piping systems and containers that are subject to failure in a fire where automatic suppression is not provided throughout.
(e) Credible environmental factors, such as rain and snow, where the installation is outside.

Criteria (a) and (c) do not apply in this case. Flammable or combustible liquids will not be stored in the building. Paragraph (c) doesn't apply because an automatic suppression system is being put in the building.

Factory Mutual Data Sheet 2-8N, Sept 2001, shows that relatively few sprinkler heads are actually opened in most fires. A study of industrial fires has shown that the majority of fires are extinguished or controlled by five sprinklers or less. The water application from 12 sprinkler heads was used for this application since that is the number of heads in the treatment area, where potential radioactive materials could be processed. Each sprinkler covers 130 sf. A density of 0.17 gal/sf was used. The density is documented in the Fire Hazard Analysis (FHA) report and was developed by treating this building as an Ordinary Hazard Group II Occupancy. Based on this occupancy, the density was derived from the Area/Density Curves shown on Figure 7-2.3.1.2 in NFPA 13. This chart is attached.

An estimate of 2000 gallons was used for the quantity of runoff water from the potential of the piping systems and containers in the building, which could fail in a fire.

The estimate of runoff from credible environmental factors, such as rain and snow, where the installation is outside is included in the calculations shown below:

Calculations:

130 sf/sprinkler x 12 heads x 0.17 gal/sf/min x 30 min	=	7956 gal
Contents of piping systems		2000 gal
*Precipitation = 0.21 ft x101.16 x 72 x 7.48	=	11350gal
Total		21306 gal

*NOAA Records for 1994-2000

- 174.9 inches of snow for approximately 25 inches per year
- 17.5 inches of water in the snow or 0.21 ft/yr

There is a minimum of 23,250-gal volume provided. This volume of 23,250 was originally developed from Factor Mutual Criteria but was later changed when it was determined that the NFPA -801 criteria applied in this case because of the potential of radioactive material being handled in the building. (The 23,250-gal was derived from a density of 0.15 gal/sf/min over the most remote 3500 sf for 30 min. In addition, a manual fire fighting flow of 250 gpm was added making a total of 23,250-gal of required

storage during a fire. 0.15-gal/sf/min x 3500 sf x 30 min + 250 gal/min x 30 min = 23,250 gal) Since the required storage of 21,306-gal is very near the 23,250-gal originally calculated, the drainage system design will remain the same.

In the event there is a fire in the Decontamination Building, it is intended to configure the contaminated equipment holding pad (CEHP) so this water can be piped and temporarily stored on the CEHP adjacent to the decon building. The concrete pad will be lowered 1 ft below the finished floor of the building. It will also be sloped 0.015 ft/ft away from the building. Fire water will be collected in a trench or catch basin in the building and piped through a 12-in HDPE pipe by gravity to the holding pad. The pad will have a 8-in.-wide curb around the perimeter to contain the spent fire water and any accumulated precipitation. It should be noted that a fire is an upset condition and is not a normal or routine event.

After the fire, the runoff water will be drained back through the 12-in pipe into a 6-inch HDPE pipe through an oil/water separator to a lift station. The water will then be pumped to the evaporation ponds in the ICDF Complex for disposal. Using a 25-gpm pump the water could be disposed of in less than 15 hours.

This EDF documents the geometry and design of the storage pad, the piping, trenching and lift station of this system.

The CEHP has been sized to accommodate 23,250-gallon which provides a safety factor of about 9% over the 21,306-gallon volume. In addition, credit has not been taken for the amount of water that can be stored in the piping and trenches. Following is a summary of the design:

- The 12-inch piping has been sized to transport the water to the pad from the affected floor area without flooding the floor and causing the water to run out of the building onto the ground.
- The trenches will be approximately 2-ft wide. The drain in the treatment portion of the building will be 4 ft square. The collected decontamination water and firewater will be directed to the main pipe by piping down to the main header pipe.
- The lift station will have two 2-HP pumps, which will operate alternately to pump decon/firewater to the evaporation ponds. Each pump will pump a minimum of 25 gpm.

Safety Category: Low Safety Consequence (LSC)

QUALITY LEVEL	☐ 1	☐ 2	3
KEYWORDS (e.g. area, structure no., general subject matter, etc.):	SSSTF, ICDF, Firewater, Lift Station, Storage		

AUTHOR/P.E. STAMP

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Checked M. O. Pettet, PE	DATE 3/1/2	Approver: S. L. Austad, PE C. J. Hurst, PE
Independent Peer Reviewer M. H. Doornbos, PE (ORB Chair)	DATE 3/8/02	BBWI Requestor R. L. Davison

DATE: 3/1/02; 3/6/02; 3/7/02

Hand calculations were initially performed to size the drainpipe from the building to the pad. These calculations were verified using PIPE-FLO (Version 6.08) computer software. Copies of both sets of calculations are attached.

First Set of Calculations (Sheets 1-15)

Sheet 1/15 of the PIPE-FLO calculations shows the pipe layout with supporting data on sheets 2-7 of 15. The data above the reservoirs shows the pressure at a certain number of feet above the reference elevation. For example, -.00362@2 represents a negative 0.1-inch of pressure at 2 ft above the 97.7 reference elevation. (Actual elevation 4922.7)

Sheet 8/15 shows the flow that can be expected at the END STATE of the system. This is when the total 23,250-gallon of firewater has been discharged and the system has stabilized. If additional water were added, the 12-inch pipe out to the holding pad would have a potential of carrying 940.5 gpm. This assumes very little (1.555 gpm in pipe 4) would be going to the lift station because the lift station would be at elevation 99.54 (Actual Elevation 4924.54) (El 92.45 + 7.09 ft from sheet 1) which is near the elevation of 99.7 in the building (El 97.7 + 2 ft from sheet 1).

Sheet 12/15 shows the flow situation at the INITIAL STATE. This is assuming the total flow of 775 gpm is coming from reservoir 2 (the decon portion of the building). This sketch shows 457 gpm in the 6-inch pipe going from reservoir 2 to the lift station and 318 gpm going to the CEHP at reservoir 4.

Second Set of Calculations (Sheets 1-7)

The second set of calculations is seven sheets of hand calculations. The first option was to use an 18-inch HDPE pipe from the Decontamination Building to CEHP. This concept routed the pipe outside the building and then back to the CEHP.

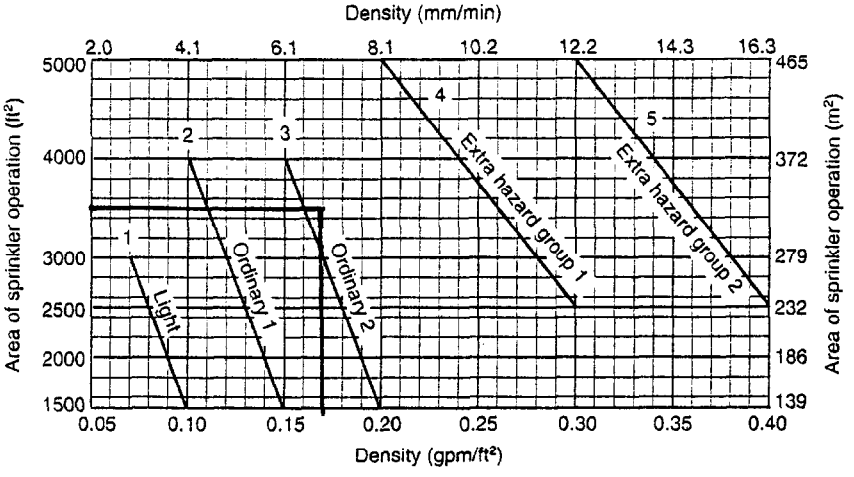
To reduce the size of pipe, a 12-in was routed under the building directly to the contaminated equipment storage pad. Using the 12-in pipe with the 775 gpm flow caused a 0.37ft head loss from the building to the CEHP. This closely approximates the computer calculations and reduces the size of pipe required.

Third Set of Calculations (Sheets 1-17)

The first 3 sheets of this calculation show the horsepower required to pump 25 gpm of water from the decontamination building to the evaporation pond. These calculations were verified using the PIPE-FLO Software.

Since the requirements for this pump are the same as that required for the sanitary sewer lift station, it is proposed to purchase 5-two horsepower pumps of the same model. Two pumps will be put in each lift station with one extra pump for a spare. This will provide for a greater flexibility in maintaining the pumps and greater ease in changing them out when the need arises.

Figure 7-2.3.1.2 Area/density curves.



7-2.3.1.3 Regardless of which of the two methods is used, the following restrictions shall apply:

(a) For areas of sprinkler operation less than 1500 ft² (139 m²) used for light and ordinary hazard occupancies, the density for 1500 ft² (139 m²) shall be used. For areas of sprinkler operation less than 2500 ft² (232 m²) for extra hazard occupancies, the density for 2500 ft² (232 m²) shall be used.

(b) *For buildings having unsprinklered combustible concealed spaces (as described in 5-13.1.1 and 5-13.7), the minimum area of sprinkler operation shall be 3000 ft² (279 m²).

Exception No. 1: Combustible concealed spaces filled entirely with noncombustible insulation.

Exception No. 2: Light or ordinary hazard occupancies where noncombustible or limited combustible ceilings are directly attached to the bottom of solid wood joists so as to create enclosed joist spaces 160 ft³ (4.8 m³) or less in volume.*

Exception No. 3: Concealed spaces where the exposed surfaces have a flame spread rating of 25 or less and the materials have been demonstrated to not propagate fire in the form in which they are installed in the space.*

(c) Water demand of sprinklers installed in racks or water curtains shall be added to the ceiling sprinkler water demand at the point of connection. Demands shall be balanced to the higher pressure. *(See Chapter 8.)*

(d) Water demand of sprinklers installed in concealed spaces or under obstructions such as ducts and cutting tables need not be added to ceiling demand.

(e) Where inside hose stations are planned or are required, a total water allowance of 50 gpm (189 L/min) for a single hose station installation or 100 gpm (378 L/min) for a multiple hose station installation shall be added to the sprinkler requirements. The water allowance shall be added in 50-gpm (189-L/min) increments beginning at the most remote hose station, with each increment added at the pressure required by the sprinkler system design at that point.

(f) When hose valves for fire department use are attached to wet pipe sprinkler system risers in accordance with 5-15.5.2, the water supply shall not be required to be added to standpipe demand as determined from NFPA 14, *Standard for the Installation of Standpipe and Hose Systems.*

Exception No. 1: Where the combined sprinkler system demand and hose stream allowance of Table 7-2.3.1.1 exceeds the requirements of NFPA 14, Standard for the Installation of Standpipe and Hose Systems, this higher demand shall be used.

Exception No. 2: For partially sprinklered buildings, the sprinkler demand, not including hose stream allowance, as indicated in Table 7-2.3.1.1 shall be added to the requirements given in NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

(g) Water allowance for outside hose shall be added to the sprinkler and inside hose requirement at the connection to the city water main or a yard hydrant, whichever is closer to the system riser.

(h) The lower duration values in Table 7-2.3.1.1 shall be permitted where remote station or central station waterflow alarm service is provided.

(i) Where pumps, gravity tanks, or pressure tanks supply sprinklers only, requirements for inside and outside hose need not be considered in determining the size of such pumps or tanks.

7-2.3.1.4 Total system water supply requirements shall be determined in accordance with the hydraulic calculation procedures of Section 8-4.

7-2.3.2 Area/Density Method.

7-2.3.2.1 The water supply requirement for sprinklers only shall be calculated from the area/density curves in Figure 7-2.3.1.2 or from Section 7-10 where area/density criteria is specified for special occupancy hazards. When using Figure 7-2.3.1.2, the calculations shall satisfy any single point on the appropriate area/density curve as follows:

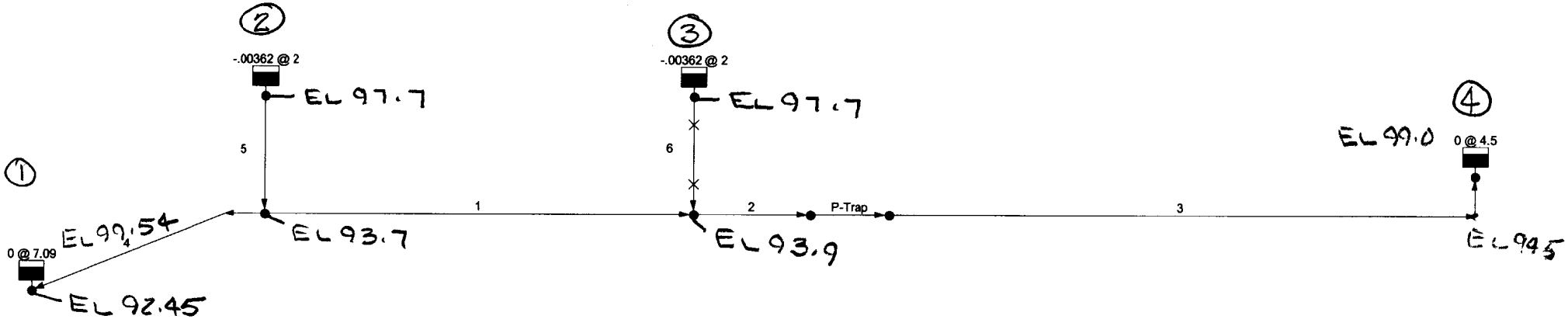
(1) Light hazard area/density curve 1
(2) Ordinary hazard (Group 1) area/density curve 2
(3) Ordinary hazard (Group 2) area/density curve 3
(4) Extra hazard (Group 1) area/density curve 4
(5) Extra hazard (Group 2) area/density curve 5

It shall not be necessary to meet all points on the selected curve.

Exception: Sprinkler demand for storage occupancies as determined in Sections 7-3 through 7-8.

7-2.3.2.2 For protection of miscellaneous storage, miscellaneous tire storage, and storage up to 12 ft (3.7 m) in height, the discharge criteria in Table 7-2.3.2.2 shall apply.

F1 SW FLOOR EL = 100.0 (ACTUA EL = 4925)



PIPE CONFIGURATION

Company:	INEEL	**System:**	SSSTF2
Project:	SSSTF - Fire Water Disposal Analysis	**Lineup:**	ENDSTATE
by:	Clint Kingsford/MARK PETTET		
Comments:	gravity fed water run off to retention basin	**flow rate:**	US gpm
		pressure:	psi_g
Version:	PIPE-FLO 6.08 04/16/01 12:14 pm	**level & grade:**	ft

Company: INEEL
Project: SSSTF - Fire Water Disposal Analysis
by: Clint Kingsford

04/16/01 12:14 pm
System: SSSTF2
rev: 04/16/01 11:58 am

PIPELIST REPORT

Created: 04/12/01 2:57 pm
Sign file:
Specs: 2

Pipes: 7
Nodes: 8
Pumps/Comps: 0

gravity fed water run off to retention basin

SPECIFICATIONS

SPECIFICATION	PIPE MATERIAL Sch / Roughness	FLUID Temp / Pres	VALVE TABLE	DESIGN LIMITS Vel / Pres
01 HDPE rev: 04/12/01 3:31 pm	Plexco Sch 50-psi 6e-005 in Size for: 6 ft/sec	Water 60 °F 0 psi g	Standard	0 / 12 ft/sec 0 / 20 psi g
02 PVC rev: 04/12/01 3:53 pm	PVCC900 Sch 100 6e-005 in Size for: 6 ft/sec	Water 60 °F 0 psi g	Standard	0 / 12 ft/sec 0 / 30 psi g

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
	01	Plexco 12 in / 50-psi	30	Water 60 °F / 0 psi g	0.2597
2	01	Plexco 12 in / 50-psi	10	Water 60 °F / 0 psi g	1.26
3	01	Plexco 12 in / 50-psi	72	Water 60 °F / 0 psi g	1.5
4	02	PVCC900 6 in / 100	26	Water 60 °F / 0 psi g	3.843
5	01	Plexco 12 in / 50-psi	4	Water 60 °F / 0 psi g	1.279
6	01	Plexco 12 in / 50-psi	3.5	Water 60 °F / 0 psi g	1.279
P-Trap	01	Plexco 36 in / 50-psi	4	Water 60 °F / 0 psi g	0

Company: INEEL
Project: SSSTF - Fire Water Disposal Analysis
by: Clint Kingsford

Created: 04/12/01 2:57 pm
Sign file:
Specs: 2

04/16/01 12:14 pm
System: SSSTF2
rev: 04/16/01 11:58 am

Pipes: 7
Nodes: 8
Pumps/Comps: 0

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SYSTEM REPORT

gravity fed water run off to retention basin

SYSTEM NODES

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
~N--001	93.7	5	1 4
~N--003	93.9	1 6	2
~N--004	94	2	P-Trap
~N--005	94	P-Trap	3
~N--006	94.5	3	
~N--007	92.45	4	
~N--008	97.7		5
~N--009	97.7		6

PIPELINE	SPEC	FROM_NODE	TO_NODE	PUMP/COMP
	01	~N--001	~N--003	.
	01	~N--003	~N--004	.
3	01	~N--005	~N--006	.
4	02	~N--001	~N--007	.
5	01	~N--008	~N--001	.
6	01	~N--009	~N--003	.
P-Trap	01	~N--004	~N--005	.

Company: INEEL
Project: SSSTF - Fire Water Disposal Analysis
by: Clint Kingsford

Created: 04/12/01 2:57 pm
Design file:
Specs: 2

04/16/01 12:14 pm
System: SSSTF2
rev: 04/16/01 11:58 am

Pipes: 7
Nodes: 8
Pumps/Comps: 0

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MATERIALS REPORT

gravity fed water run off to retention basin

PIPE MATERIALS LIST

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
1	01	Plexco 12 in / 50-psi	30	1-Tee Flow Thru Run
2	01	Plexco 12 in / 50-psi	10	1-Exit Sharp-Edged 1-Tee Flow Thru Run
3	01	Plexco 12 in / 50-psi	72	1-Entrance Sharp-Edged 1-Exit Sharp-Edged
4	02	PVCC900 6 in / 100	26	1-Entrance Sharp-Edged 1-Exit Projecting 1-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Branch 1-Reducer Contraction 12 X 6 1-Exit Sharp-Edged
	01	Plexco 12 in / 50-psi	4	1-Entrance Sharp-Edged 1-Tee Flow Thru Branch
6	01	Plexco 12 in / 50-psi	3.5	1-Entrance Sharp-Edged 1-Tee Flow Thru Branch
P-Trap	01	Plexco 36 in / 50-psi	4	

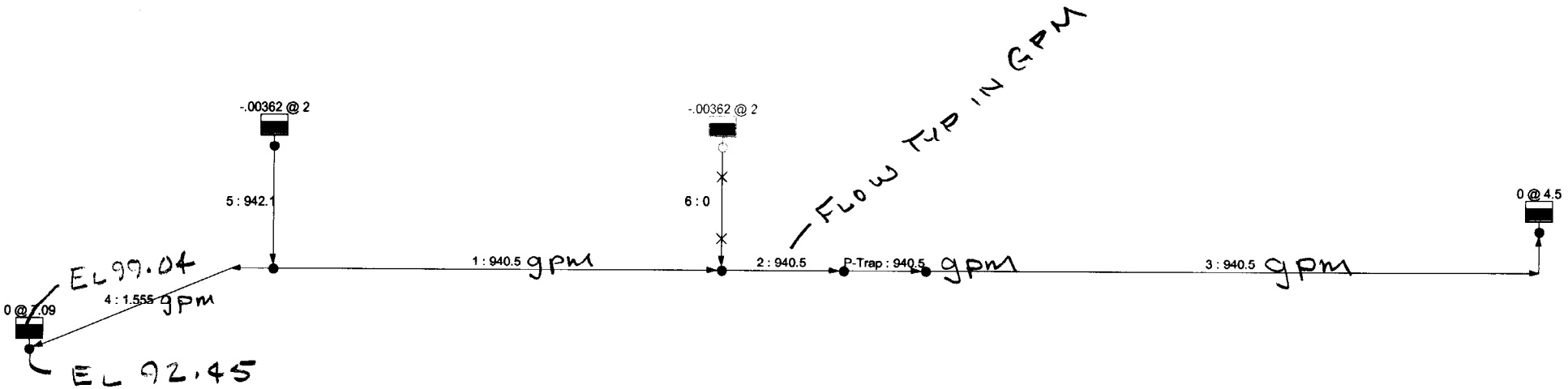
PIPE MATERIALS SUMMARY

PIPE MATERIAL	SCHEDULE	SIZE	LENGTH
Plexco	50-psi	12 in	119.5 ft
		36 in	4 ft
PVCC900	100	6 in	26 ft

TOTAL SYSTEM VOLUME: 920.2 gallons

VALVE & FITTING SUMMARY

SPECIFICATION	MATERIAL	SCHEDULE	VALVES & FITTINGS
01 HDPE	Plexco	50-psi	
	Size: 12 in		2-Tee Flow Thru Run
			2-Exit Sharp-Edged
			3-Entrance Sharp-Edged
			2-Tee Flow Thru Branch
02 PVC	PVCC900	100	
	Size: 6 in		1-Entrance Sharp-Edged
			1-Exit Projecting
			1-Elbow Short - r/d 1 @ 90°
			1-Tee Flow Thru Branch
			1-Reducer Contraction 12 X 6
			1-Exit Sharp-Edged



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FLOW CONDITIONS

Company:	INEEL	**System:**	SSSTF2
Project:	SSSTF - Fire Water Disposal Analysis	**Lineup:**	ENDSTATE
by:	Clint Kingsford	**Nodes:**	Grades
Comments:	System flow at the end of 30 minutes (everything full)	**flow rate:**	US gpm
		pressure:	psi_g
Version:	PIPE-FLO 6.08 04/16/01 12:15 pm	**level & grade:**	ft

LINEUP REPORT

9/15

:m: SSSTF2
rev: 04/16/01 11:58 am

Deviation: 1.31 %
after: 6 iterations

System flow at the end of 30 minutes (everything full)

Volumetric flow rates require constant fluid properties in all pipelines. Fluid properties in the most common specification were used.(den = 62.37 lb/ft³).

LINEUP SUMMARIES

PIPELINE		FLOW US gpm	PRESSURE SOURCE	SET psi g	LEVEL ft
3	>>>	940.5	~N--006	0	4.5
4	>>>	1.555	~N--007	0	7.09
5	<<<	942.1	~N--008	-0.004	2

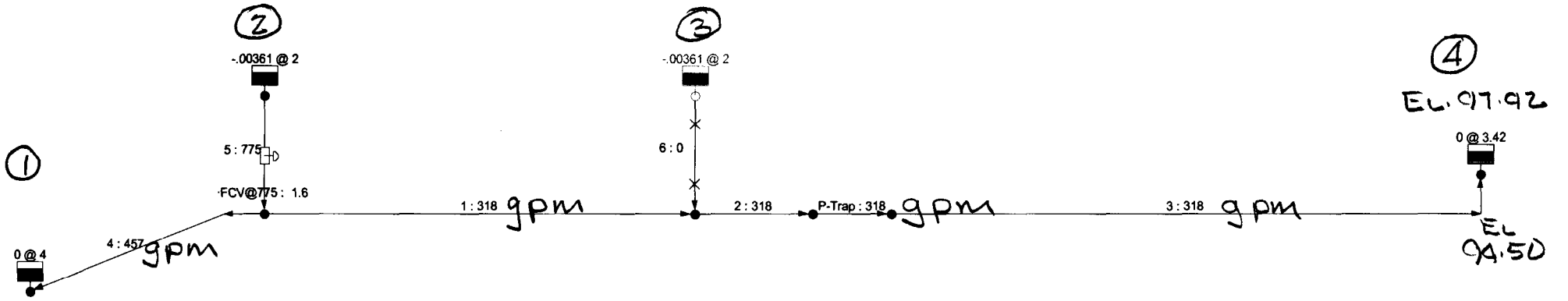
Flows IN: 942.1 US gpm
Flows OUT: 942.1 US gpm

NET FLOWS: 0 US gpm

10/16

NODE	ELEVATION ft	DEMAND US gpm	PRESSURE psi g	H GRADE ft
)01	93.7		2.528	99.54
~N--003	93.9		2.406	99.46
~N--004	94		2.292	99.3
~N--005	94		2.292	99.3
~N--006	94.5		1.948 (source)	99
~N--007	92.45		3.069 (source)	99.54
~N--008	97.7		0.862 (source)	99.69

PIPELINE	FROM	TO	FLOW US gpm	VEL ft/sec	dP psi	HL ft
1	~N--001	~N--003	940.5	2.707	0.122	0.082
2	~N--003	~N--004	940.5	2.707	0.113	0.161
3	~N--005	~N--006	940.5	2.707	0.345	0.296
4	~N--001	~N--007	1.555	0.016	(0.541)	0
5	~N--008	~N--001	942.1	2.711	(1.665)	0.153
6	~N--009	~N--003	closed	0	0	0
P-Trap	~N--004	~N--005	940.5	0.340	0	0



FLOW CONDITIONS

Company:	INEEL	**System:**	SSSTF2
Project:	SSSTF - Fire Water Disposal Analysis	**Lineup:**	INITIAL
by:	Clint Kingsford	**Nodes:**	Grades
Comments:	Initial flow of fire water with sumps empty (low)	**flow rate:**	US gpm
		pressure:	psi_g
Version:	PIPE-FLO 6.08 04/16/01 12:15 pm	**level & grade:**	ft

1 of 5

LINEUP REPORT

:m: SSSTF2
rev: 04/16/01 11:58 am

Deviation: 0.00226 %
after: 8 iterations

Initial flow of fire water with sumps empty (low)

Volumetric flow rates require constant fluid properties in all pipelines. Fluid properties in the most common specification were used.(den = 62.37 lb/ft^3).

LINEUP SUMMARIES

PIPELINE		FLOW US gpm	PRESSURE SOURCE	SET psi g	LEVEL ft
3	>>>	318	~N--006	0	3.42
4	>>>	457	~N--007	0	4
5	<<<	775	~N--008	-0.004	2

Flows IN: 775 US gpm
Flows OUT: 775 US gpm

NET FLOWS: 0 US gpm

NODE	ELEVATION ft	DEMAND US gpm	PRESSURE psi g	H GRADE ft
)01	93.7		1.856	97.99
~N--003	93.9		1.764	97.98
~N--004	94		1.713	97.96
~N--005	94		1.713	97.96
~N--006	94.5		1.48 (source)	97.92
~N--007	92.45		1.731 (source)	96.45
~N--008	97.7		0.862 (source)	99.69

PIPELINE	FROM	TO	FLOW US gpm	VEL ft/sec	dP psi	HL ft
1	~N--001	~N--003	318	0.915	0.091	0.011
2	~N--003	~N--004	318	0.915	0.051	0.019
3	~N--005	~N--006	318	0.915	0.233	0.037
4	~N--001	~N--007	457	4.637	0.124	1.537
5	~N--008	~N--001	775	2.23	(1.687)	0.104
----- FCV@775 ----- dP: 0.693 HL: 1.6						
6	~N--009	~N--003	closed	0	0	0
P-Trap	~N--004	~N--005	318	0.115	0	0

SSSTF CLINTON KINGSFORD 4.10.01

HAND CALCS

GIVEN

- ATTACHED SKETCHES
- FIREWATER FLOW 0.15 GAL/S.F OVER THE MOST REMOTE 3500 S.F PLUS ONE FIRE HOSE @ 250 GPM. FOR 30 MIN (23,250 gal) FROM FACTORY MUTUAL CRITERIA.
- ASSUME 18" HDPE PIPE TO DRAIN BLDG OF FIREWATER

FIND

PIPE SIZE TO DRAIN BUILDING IN THE EVENT OF A FIRE

SOLUTION (FIRST TRIAL)

18" HDPE PIPE $A_{CEA} = \pi r^2 = (0.75)^2 \pi$

$A = 1.77 \text{ FT}^2$ ←

DESIGN FLOW = 3500 S.F. × 0.15 GAL/S.F. = 525 GPM

\+ FIREHOSE FLOW 250 GPM

TOTAL 775 GPM ←

$Q = \frac{775 \text{ GAL/MIN}}{448 \frac{\text{GAL/MIN}}{\text{CFS}}} = 1.73 \text{ CFS}$ ←

$V = Q/A = 1.73/1.77 = 0.98 \text{ FT/SEC}$ ←

LENGTH OF PIPE (LONGEST)

$102/5.92'' = 17.22'/\text{INCH}$.

2.50
6.70
6.30
14.50 × 17.22 = 250 L.F. ←

HYD RADIUS $R = A/P = \frac{\pi D^2/4}{\pi D} = D/4$

$R = 1.50/4 = \underline{0.375}$ ←

K VALUES (TABLE 10.2 ROBERSON/CROWE)

ENTRANCE $K = 0.50$ 0.50

90° BEND $K = 1.10 \times 3 = 3.30$

EXIT (EXP) $K =$ $D_1/D_2 = 0.6$ ~~$D_1/D_2 = 0.8 = 0.16$~~ $(0.42 - 0.16)0.75 = \underline{0.22}$

$D_1/D_2 = 1.5/2.0 = 0.75$

$\theta = 180°$

TOTAL K $\underline{4.0}$ ←

$\frac{P_1}{\gamma}^{0} + \frac{V_1^2}{2g}^{0} + Z_1 = \frac{P_2}{\gamma}^{0} + \frac{V_2^2}{2g}^{0} + Z_2 + \Sigma H_L$

$H = Z_1 - Z_2$

$H = \Sigma h_L$

FOR PIPE HEAD LOSS

$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$ $n = 0.011$ (ASSUME)

SEE PG 454 TABLE 10.3 ROBERSON & CROWE

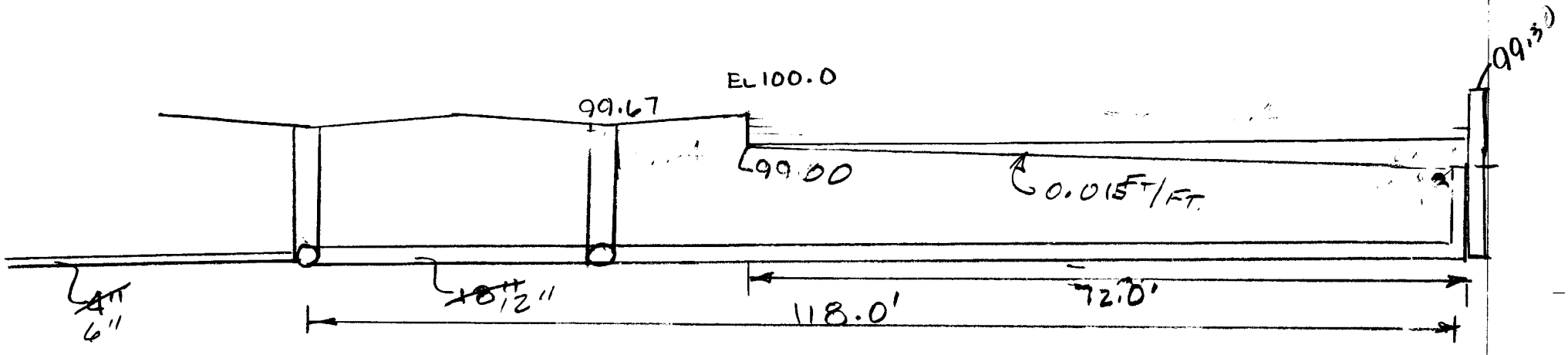
$1.73 = \left(\frac{1.49}{0.11}\right)(1.77)(0.375)^{0.52\,1/2}\left(h_f/250\right)^{1/2}$

$\frac{1.73 \times 0.011}{1.49 \times 1.77 \times 0.52} = \left(h_f/250\right)^{1/2} = 0.10139$

$\frac{h_f}{250} = 0.002$ $h_f = 0.05$ FT.

$H = \frac{V^2}{2g}(K_{e\,TOTAL}) + h_f$

$H = \frac{(0.73)^2}{64.4}(4.0) + 0.05$ $H = 0.06 + 0.05 = \underline{0.11}$ FT ←



SECTION A-A.

TOTAL VOLUME REQ'D = 775 GAL/MIN X 30 MIN = 23,250 / 7.48 GAL/C.F. = 3108 C.F. REQ'D

102.50
- 1.00 CURBS
101.50 FT. $\left[\frac{(99.4 - 99.30) + (99.4 - 98.58)}{2}\right]$ X 72 = 3361

PIPE 1.77 X 250 = 442

3803

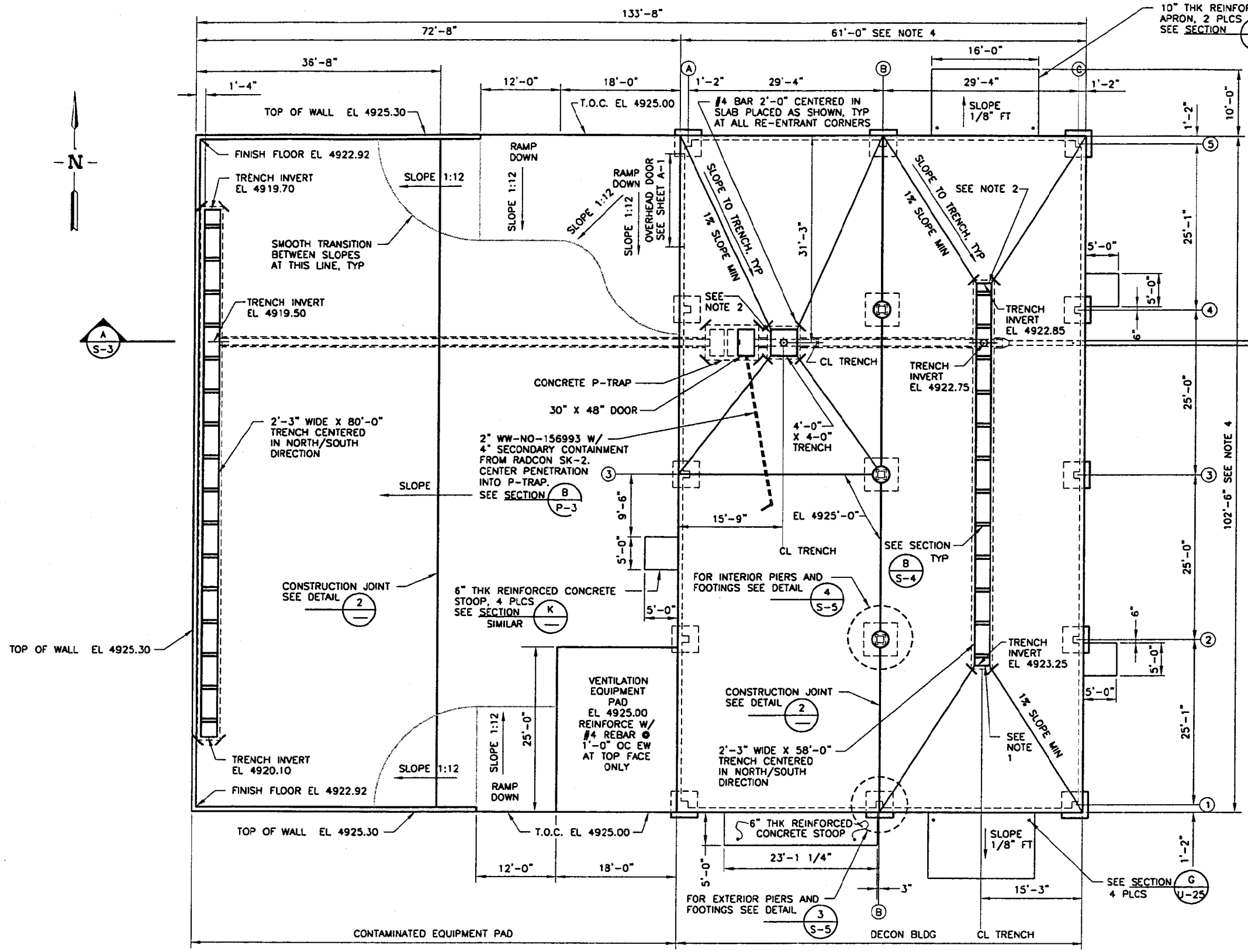
PAD = 15 X 20 X 0.9 = 270 C.F.

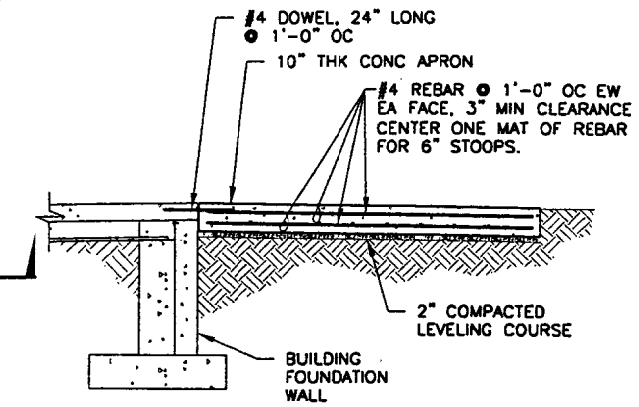
3803
- 270
3533 > 3108 C.F. OK.

3/7

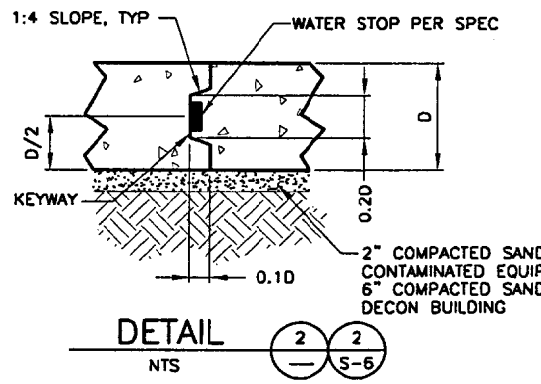
REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE

4a/7





SECTION K
SCALE: 3/8" = 1'-0"



DETAIL 2 S-6
NTS

NOTES

1. UNLESS OTHERWISE SHOWN, ALL CONCRETE FLOOR SLABS ARE TO BE A UNIFORM THICKNESS OF 5".
2. FINISHED FLOOR AT TRENCH 4924.75 ALL AROUND.
3. FINISHED FLOOR AT TRENCH 4924.67.
4. PROVIDE SECONDARY CONTAINMENT LINER SYSTEM UNDER THE FLOOR. SEE PLANS AND SPECS.
5. REINFORCE RAMP PORTIONS WITH TWO LAYERS (2" AND 8" MAX FROM TOP OF SLAB) OF WELDED WIRE FABRIC PER SPEC.

DECON BLDG FOUNDATION AND PAD PLAN

PROFESSIONAL ENGINEER REGISTERED 7574 STATE OF IDAHO DAVID L. STEPHENS

FOR DRAWING INDEX SEE DRAWING NO. 520003	SUBCONTRACT NO.
SCALE: 1/8" = 1'-0"	REQUESTER: S.A. DAVIES
	DESIGN: DAVID STEPHENS
	DRAWN: KEITH BRONSON
	PROJECT NO. 020996
	SPEC CODE
DESIGN PHASE: AFC	FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO. 88704
SAFETY CATEGORY: LSC	EFFECTIVE DATE

INEEL Idaho National Engineering & Environmental Laboratory BECHTEL BWXT IDAHO, LLC

INTEC
STAGING, STORAGE, SIZING AND TREATMENT FACILITY

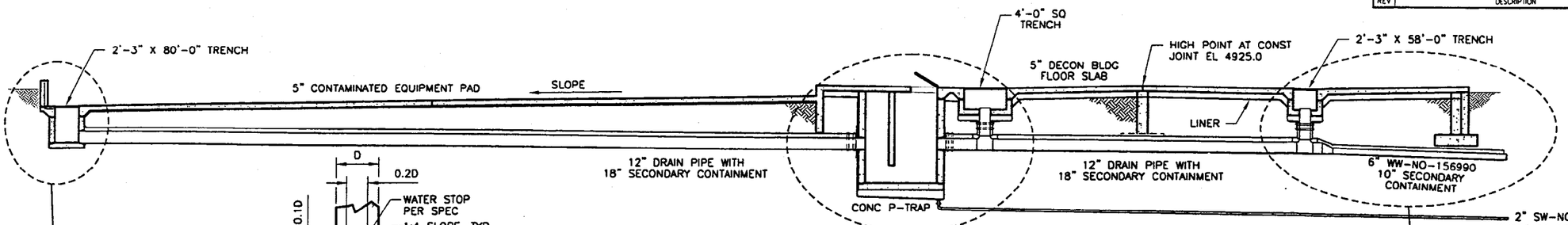
DECON BLDG FOUNDATION AND PAD PLAN

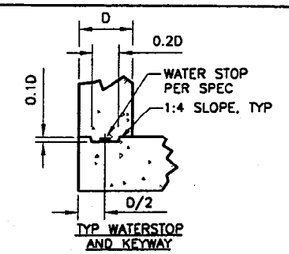
SIZE	CAGE CODE	INDEX CODE NUMBER				DWG- 520047	REV
		AREA	TYPE	LOT	ORIG		
D	01MF3	200	1688	62	090		
SCALE: 1/8"=1'-0"						SHEET S-2	

Layout Name: 520047
Date: 02/07/02 - 3:52 P.M.
ID: MBC
File: 520047.dwg
Path: G:\dgn\SSS1F

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE

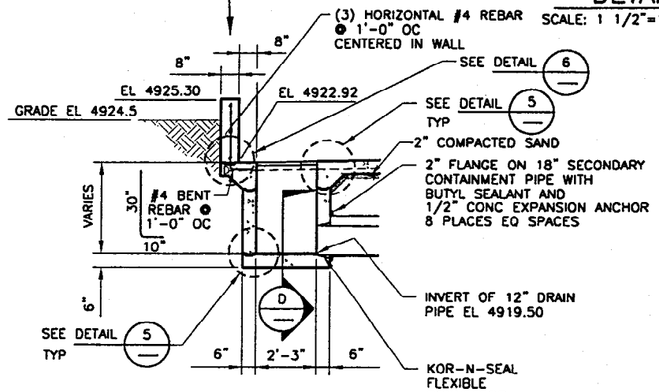
46/7

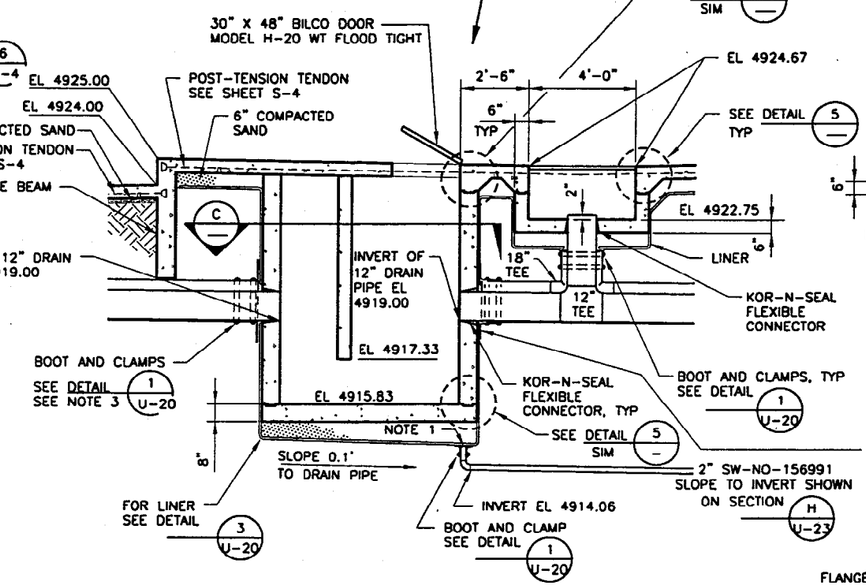


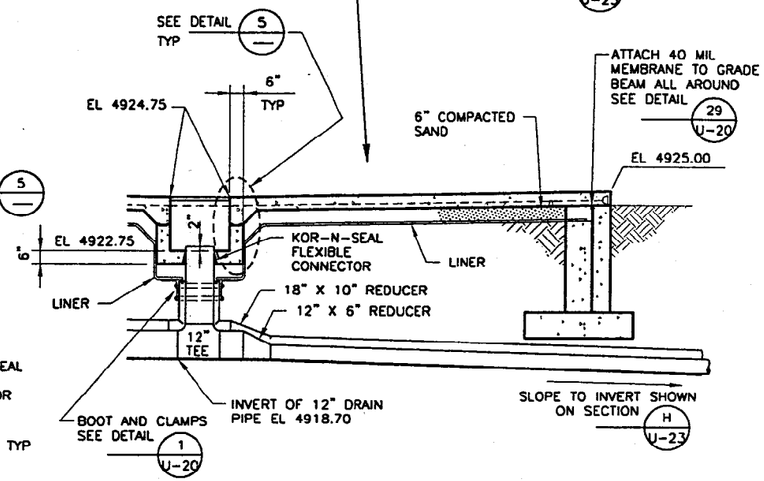


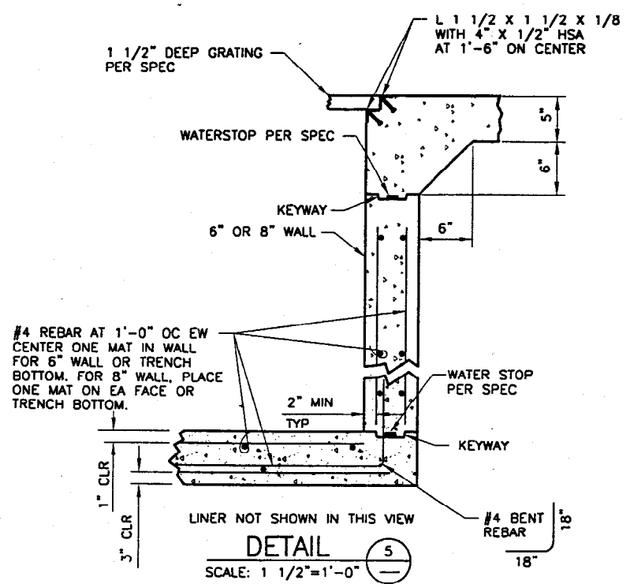
SECTION
SCALE: 3/16=1'-0" (A / S-2)

DETAIL
SCALE: 1 1/2"=1'-0" (6 / S-4)

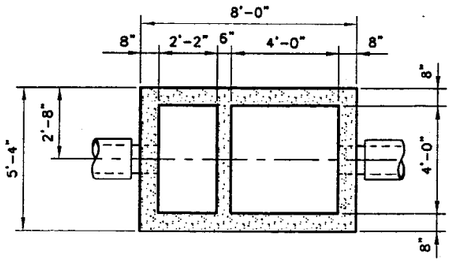






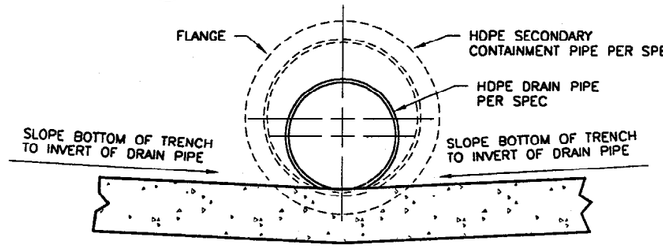


DETAIL
SCALE: 1 1/2"=1'-0" (5)



LINER NOT SHOWN IN THIS VIEW

SECTION
SCALE: 3/8"=1'-0" (C)



SECTION
SCALE: 1 1/2"=1'-0" (D)

NOTES

1. PLACE GEOCOMPOSITE PORTION OF LINER OVER END OF PIPE TO PREVENT SAND FROM GOING INTO PIPE.
2. FOR LINER SEE SHEET U-20.
3. PROVIDE DRAINAGE PATH FROM 18" CONTAINMENT PIPE TO LINER

PROFESSIONAL ENGINEER REGISTERED 7574 STATE OF IDAHO DAVID L. STEPHENS

FOR DRAWING INDEX SEE DRAWING NO. 520003	SUBCONTRACT NO.
SCALE: 3/16" = 1'-0"	REQUESTER: S.A. DAVIES
SCALE: 3/8" = 1'-0"	DESIGN: DAVID STEPHENS
	DRAWN: KEITH BRONSON
	PROJECT NO. 020996
	SPEC CODE
DESIGN PHASE: AFC	FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO. 88704
SAFETY CATEGORY: LSC	EFFECTIVE DATE:

INEEL — Battelle Energy Alliance, LLC

INTEC
STAGING, STORAGE, SIZING AND TREATMENT FACILITY

SECTIONS AND DETAILS

SIZE	CAGE CODE	INDEX CODE NUMBER AREA	TYPE	CL	ORIG	DWG-	REV
D	01MF3	200	1688	62	090	520048	

SCALE: NOTED — SHEET S-3

Plot-01-REV 3.3
Layout Name: 520048
Date: 02/07/02 - 4:14 P.M.
ID: MBC
File: 520048.dwg
Path: G:\dgn\SSSJF

REVISE CALCULATIONS FOR 12" Ø HDPE PIPE

GIVEN

12" Ø HDPE (LENGTH 118')
Q = 1.73 CFS

SOLUTION.

AREA OF 12" Ø PIPE = 0.785 FT2

$$\frac{P_1}{\gamma}^{0} + \frac{V_1^2}{2g}^{0} + z_1 = \frac{P_2}{\gamma}^{0} + \frac{V_2^2}{2g}^{0} + z_2 + \Sigma h_L$$

$P_1 = P_2 = 0$ GAGE $\quad V_1 = V_2 = 0$

K VALUES

ENTRAINCE	0.5
1 BEND	1.1
EXIT	0.5
TOTAL K	2.1

$$V = Q/A = \frac{1.73}{0.75} = 2.31 \text{ FT/SEC}$$

PIPE HEAD LOSS & MISC LOSSES

$$H = \frac{V^2}{2g}(K_T) + \text{PIPE HEAD LOSS}$$

$$R = A/P = \frac{\pi D^2/4}{\pi D}$$

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} \qquad R = \frac{R}{4} = \frac{1}{4} = 0.25$$

$$S^{1/2} = \frac{Q n}{1.49(A)(R^{2/3})}$$

$$S^{1/2} = \frac{1.73 \times 0.011}{0.785 \times (0.25)^{2/3} (1.49)} \qquad S = \frac{h_f}{118}$$

$0.25^{2/3} = 0.40$

$$\left(\frac{h_f}{118}\right)^{1/2} = 0.041$$

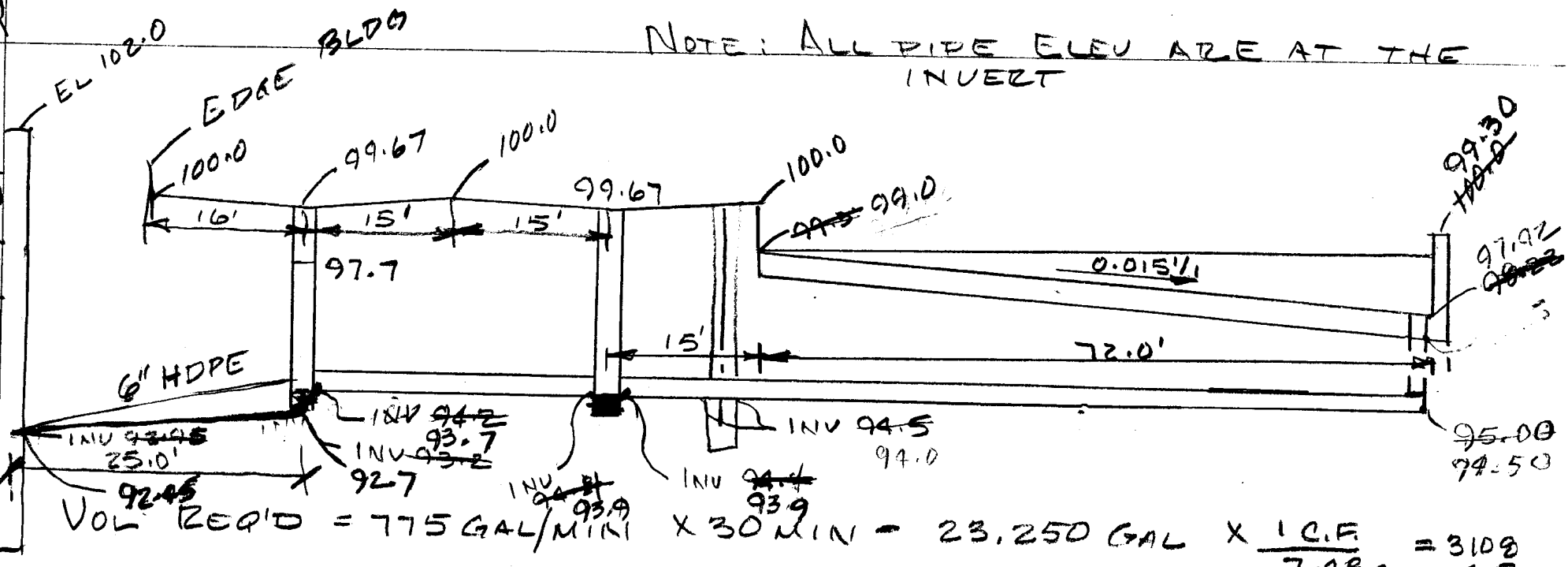
$$h_f = 0.0017(118) = 0.20 \text{ PIPE HEAD LOSS}$$

$$H = \frac{V^2}{2g}(K_T) + h_f$$

$$H = \frac{(2.31)^2}{64.4}(2.1) + 0.2 \qquad H = 0.37 \leftarrow \text{TOTAL HEAD LOSS}$$

SSSTF CLINT KINGSFORD 4.11.01

NOTE: ALL PIPE ELEV ARE AT THE INVERT



VOL REQ'D = 775 GAL/MIN X 30 MIN = 23,250 GAL X $\frac{1 \text{ C.F.}}{7.48 \text{ GAL}}$ = 3108 C.F.

ACTUAL VOL = $\frac{1}{2}$ X 72 (99.30 - 98.22)(101) = 3926 C.F.

VOL HEPA PAD = -270

VOL OF PIPE 0.785 X 118 = 93

NET VOL 3748 C.F. > 3108 C.F. OK.

SECTION A-A

ASSUME SAME DENSITY AS
MINERAL PROCESSING TABLE G OF FACTORY MUTUAL DATA SHEET 3.26

DRY SYSTEM ⇒ 0.15 gpm/ft²/3500 ft²
+ 250 gpm HOSE STREAM

∴ .15 × 3500 ⇒ 525 gpm
+ 250 gpm

TOTAL GALLONS/MIN = 775 × 30 MINUTES

TOTAL RUN OFF ⇒ 23,250 GALLONS.

USING NFPA 801 FIRE WATER RUNOFF
SECTION 3-10.2.1

$$\frac{800 \text{ gpm}}{3500 \text{ ft}^2} = .23 \text{ gpm/ft}^2$$

$$\simeq .25$$

GIVEN LIFT STATION.

- 4' Ø BASIN FOR 2 - 25 GPM PUMPS (2 HP)
- DESIGN FLOW 25 GPM.
- ATTACHED SKETCH
- 1070 FT FROM LIFT STA TO EVAP POND
- TRY 2" Ø HDPE PRESSURE LINE

  I.D = 2.05 IN
- LENGTH 220 + 440 + 410 = 1130 FT

FIND

HEAD REQ'D FOR PUMP

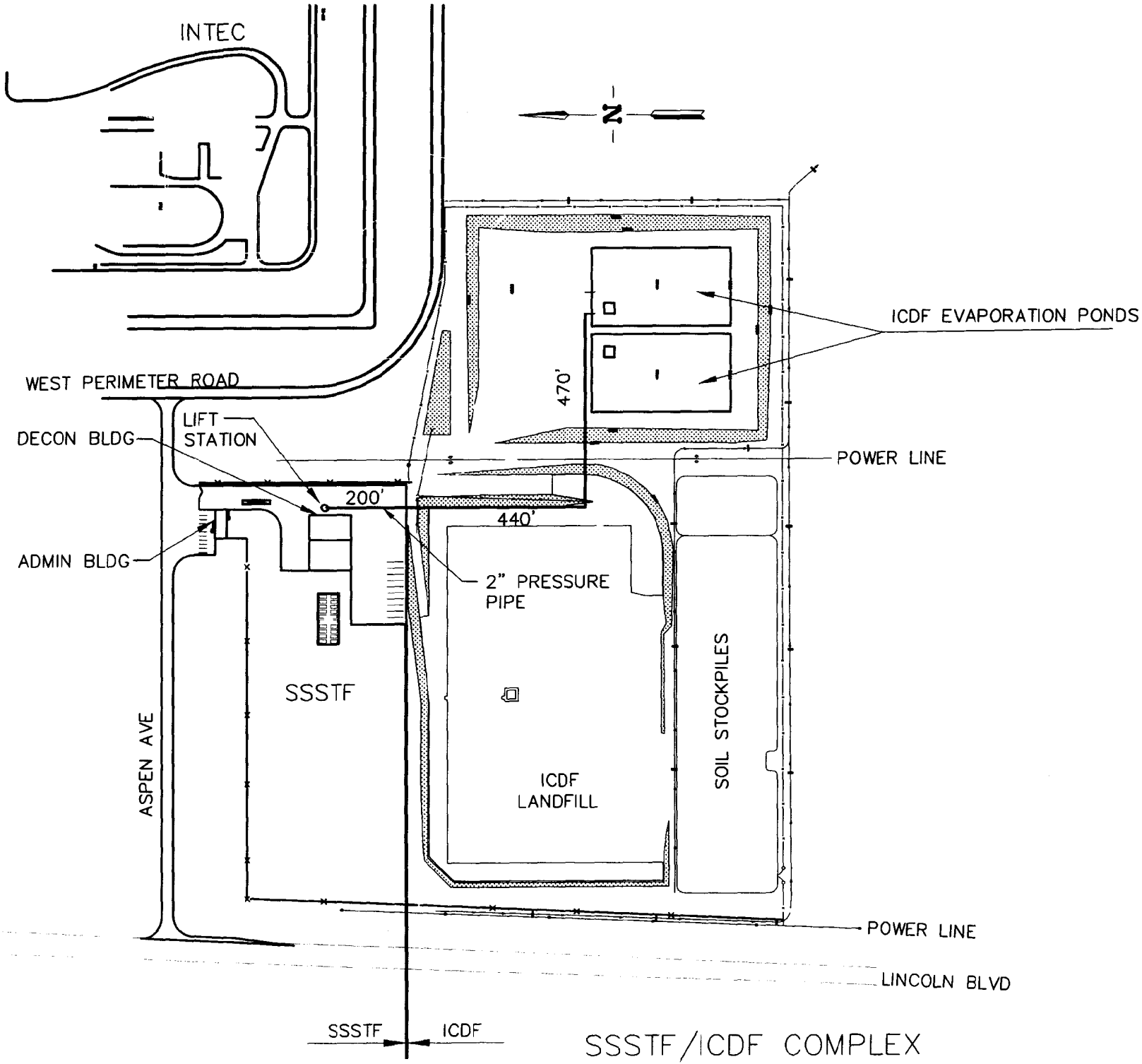
SOLUTION

AREA OF 2" Ø PIPE $= \pi r^2 = \pi \left(\frac{2.05}{2}\right)^2 = 3.3 \text{ IN}^2$

$= 0.023 \text{ FT}^2$

$$\text{FLOW} = \frac{25 \text{ GAL/MIN}}{448.8 \frac{\text{GAL/MIN}}{\text{CFS}}} = 0.056 \text{ CFS}$$

$Q = AV \quad V = Q/A = \frac{0.056}{0.023} = 2.42 \text{ FT/SEC} < 3.0 \text{ FT/SEC}$



SSSTF/ICDF COMPLEX

DECON LIFT STA 4.30.01

TOTAL LENGTH OF 2"Ø PIPE = 1130 L.F.

$\frac{V^2}{2g} = \frac{(2.42)^2}{64.4} = 0.09$ FT.

$d = 0.167$ FT.

$h_L = f\,L/D\,\frac{V^2}{2g} = 0.021 \times 1130/0.167 \times 0.09 = 13$ FT.

STATIC HEAD

ELEV AT EVAP POND	4933
ELEV AT LIFT PUMP	4909
	24 FT.

MINOR LOSSES

MINOR LOSS	NO.	K VALUE	TOTAL K VALUE
90° ELBOW	3	0.35	1.05
CHECK VALVE	1	2.00	2.00
45° ELBOW	5	0.35	1.75
GATE VALVE	1	0.20	0.20
EXIT LOSS	1	0.50	0.50
		TOTAL	5.5
		SAY	7.0.

MINOR LOSSES $= K\frac{V^2}{2g} = 6 \times 0.09 = 0.5$ F.

TOTAL LOSSES = 13+24+0.5 = 27.5 FT

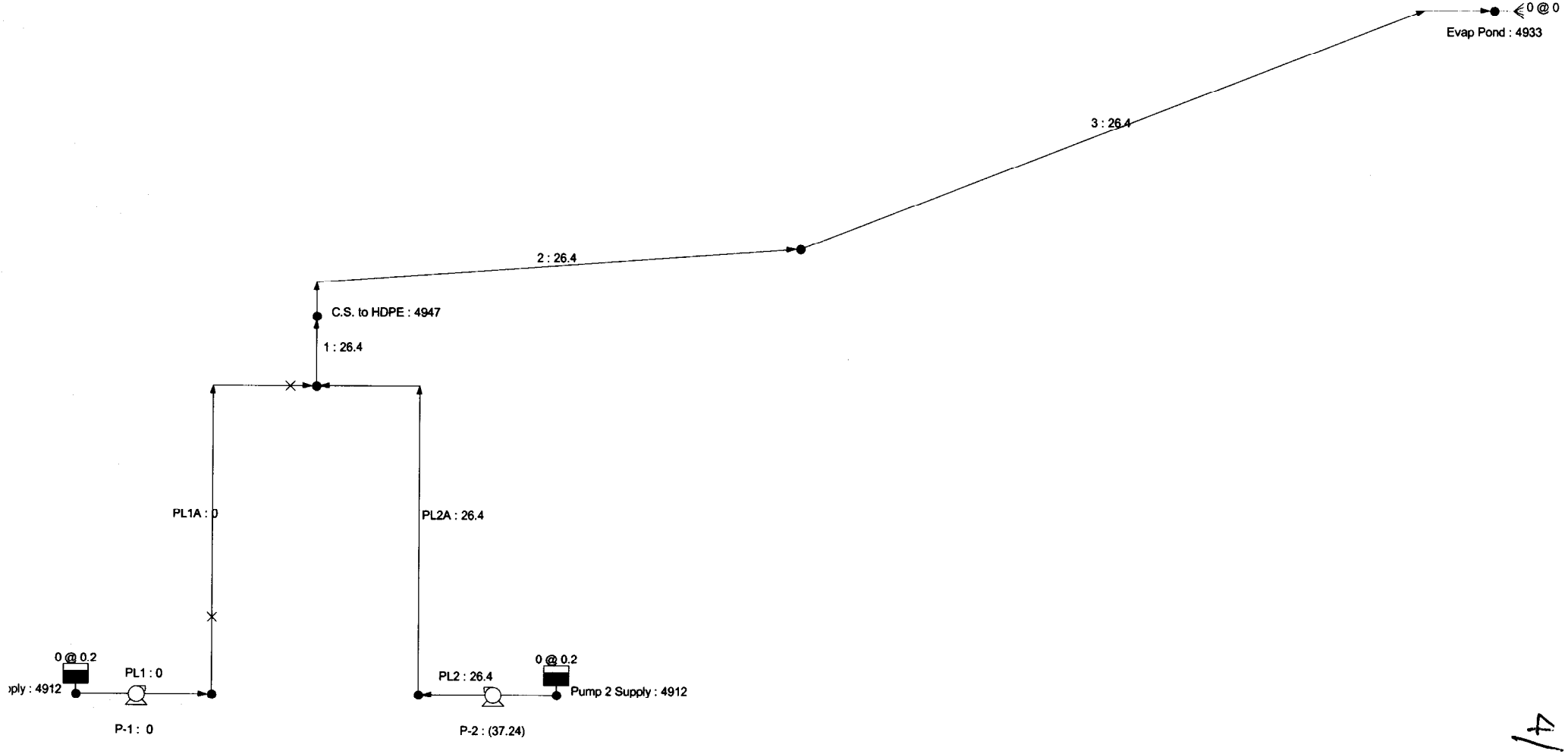
SAY 30 FT. ← TDH

HORSEPOWER OF PUMP

$$WHP = \frac{Q\,h_L\,S_G}{3960} = \frac{G/_{MIN} \times FT}{\frac{FT\text{-}GAL/_{MIN}}{HP}}$$

$$WHP = \frac{25\,GAL/_{MIN} \times 30\,FT \times 1}{3960\,FT\text{-}GAL/_{MIN}/HP} = 0.2\,HP$$

$$NET\ POWER = \frac{0.2}{0.3 \times 0.7} = 0.95 \quad \underline{SAY\ 2HP}$$



FLOW CONDITIONS WITH ONE PUMP ON LINE

Company:	INEEL	**System:**	SSSTFSMP
Project:	SSSTF	**Lineup:**	SSSTFSMP
by:	Clint Kingsford	**Nodes:**	Grades
Comments:	Decon water (sump to pond)	**flow rate:**	US gpm
		pressure:	psi_g
Version:	PIPE-FLO 6.08 07/05/01 4:02 pm	**level & grade:**	ft

LINEUP REPORT

em: SSSTFSMP
rev: 07/05/01 4:00 pm

Deviation: 0.31 %
after: 4 iterations

Volumetric flow rates require constant fluid properties in all pipelines. Fluid properties in the most common specification were used.(den = 62.37 lb/ft^3).

LINEUP SUMMARIES

PIPELINE		FLOW US gpm	PRESSURE SOURCE	SET psi g	LEVEL ft
3	>>>	26.4	Evap Pond	0	0
PL1	>>>	0	Pump 1 Supply	0	0.200
PL2	<<<	26.4	Pump 2 Supply	0	0.200

Flows IN: 26.4 US gpm
Flows OUT: 26.4 US gpm

NET FLOWS: 0 US gpm

NODE	ELEVATION ft	DEMAND US gpm	PRESSURE psi g	H GRADE ft
-002	4911.3		0.087	4912
~N--003	4911.3		16.15	4949
~N--005	4915		13.77	4947
~N--007	4917.22		11.53	4944
C.S. to HDPE	4915		13.7	4947
Evap Pond	4933		0 (source)	4933
Pump 1 Supply	4911.3		0.087 (source)	4912
Pump 2 Supply	4911.3		0.087 (source)	4912

PIPELINE	FROM	TO	FLOW US gpm	VEL ft/sec	dP psi	HL ft
1	~N--005	C.S. to HDPE	26.4	2.87	0.073	0.168
2	C.S. to HDPE	~N--007	26.4	2.499	2.176	2.807
3	~N--007	Evap Pond	26.4	2.499	11.53	10.85
PL1	Pump 1 Supply	~N--002	0	0	0	0
----- P-1 ----- dP:	HL:					
PL1A	~N--002	~N--005	closed	0	0	0
PL2	Pump 2 Supply	~N--003	26.4	2.87	(16.07)	(37.12)
----- P-2 ----- dP: (16.12) HL: (37.24) NPSHa: 28.49						
PL2A	~N--003	~N--005	26.4	2.87	2.379	1.795

SSSTF De-Con Water Pumps (sump to pond)
Clint Kingsford

PUMP-FLO ver: 6.04
04/18/01

8/17

PUMP DATA SHEET
HYDROMATIC

Selection file: SSSTFPMP.UFS
Catalog: GRIND60.MPC v .1

Des oint: Flow: 25 US gpm
Head: 36 ft

Pump: **GRINDER - 3600** **Size: G1LX200**
Speed: 3450 rpm Curve: 4.12 L

Limits: Temperature: 104 °F Sphere size: --- in
Pressure: 26 psi_g Power: 2 bhp

Specific Speed: Ns: --- Nss: ---

Dimensions: Suction: --- in Discharge: 1.25 in

Motor: --- hp NEMA Standard TEFC Enclosure
sized for Max Power on Design Curve

Fluid: Water Temperature: 60 °F
SG: 1
Viscosity: 1.122 cP
Vapor pressure: 0.25681 psi_a
Atm pressure: 12.5 psi_a

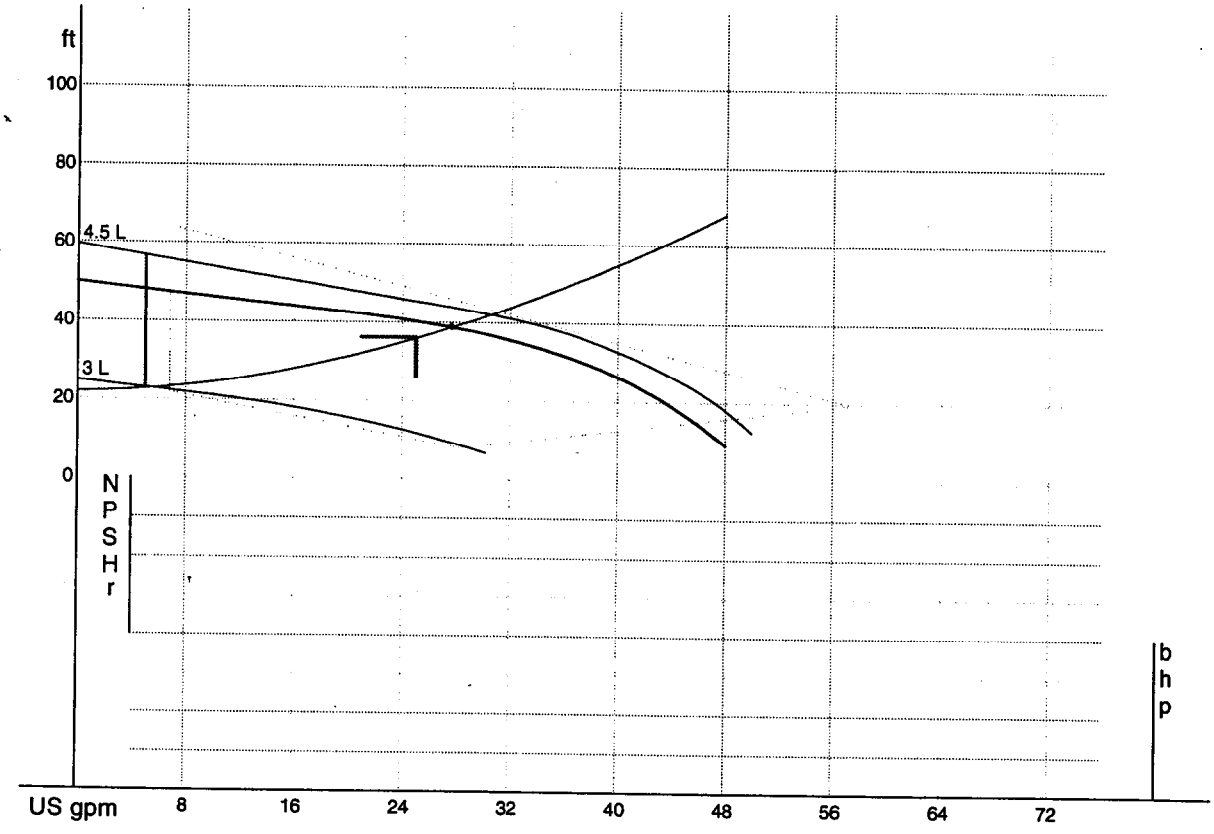
NPSHa: --- ft

Piping: System: SSSTFSMP.PLL
Suction: PL2 / 2 in
Discharge: PL2A / 2 in

---- Data Point ----
Flow: 25 US gpm
Head: 40.1 ft
Eff: - %
Power: - bhp
NPSHr: - ft

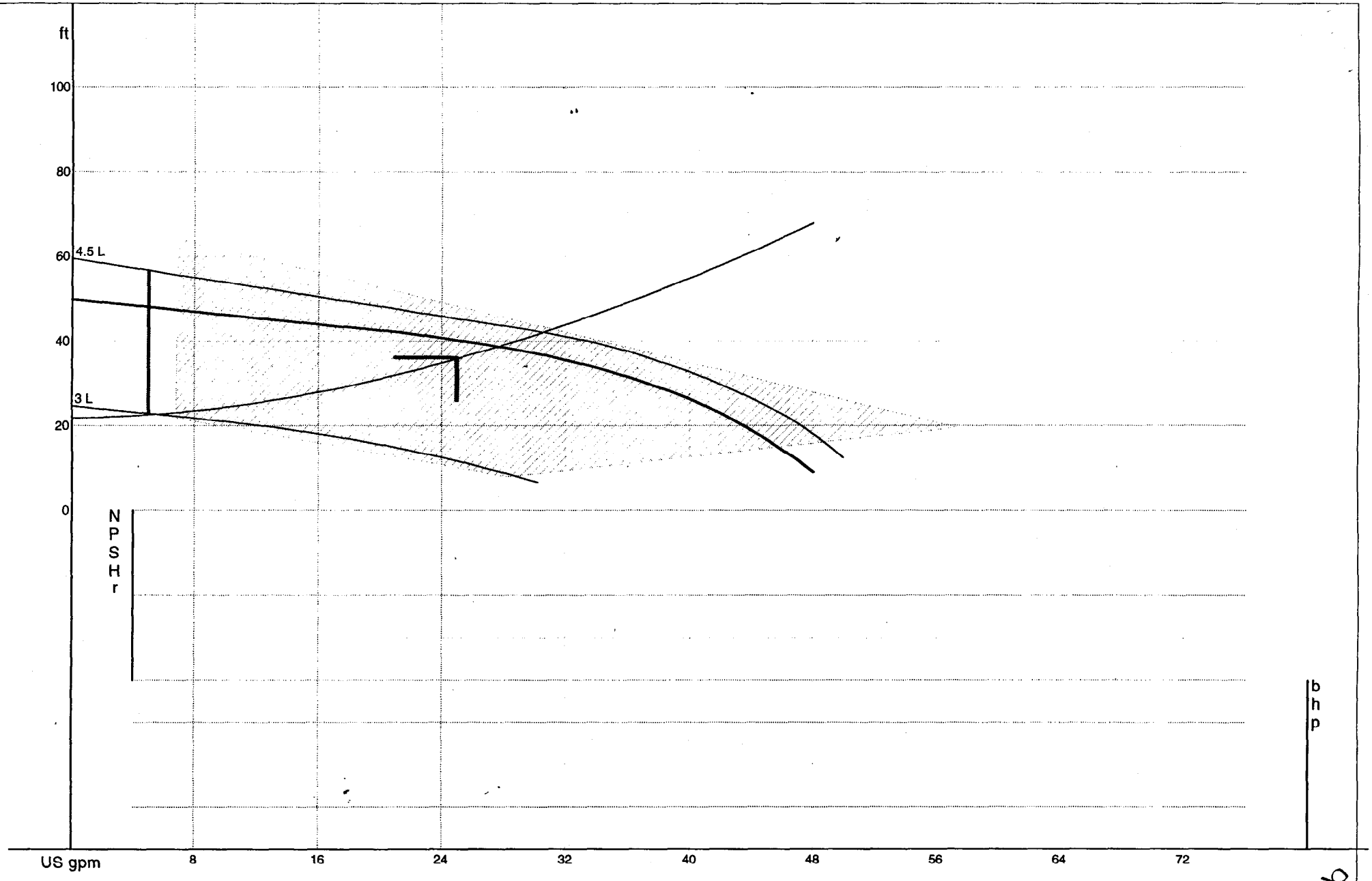
-- Design Curve --
S Head: 49.8 ft
off dP: 21.6 psi
Min Flow: 5 US gpm
BEP: - % eff
NOL Pwr: - bhp

-- Max Curve --
Max Pwr: - bhp



--- PERFORMANCE EVALUATION ---

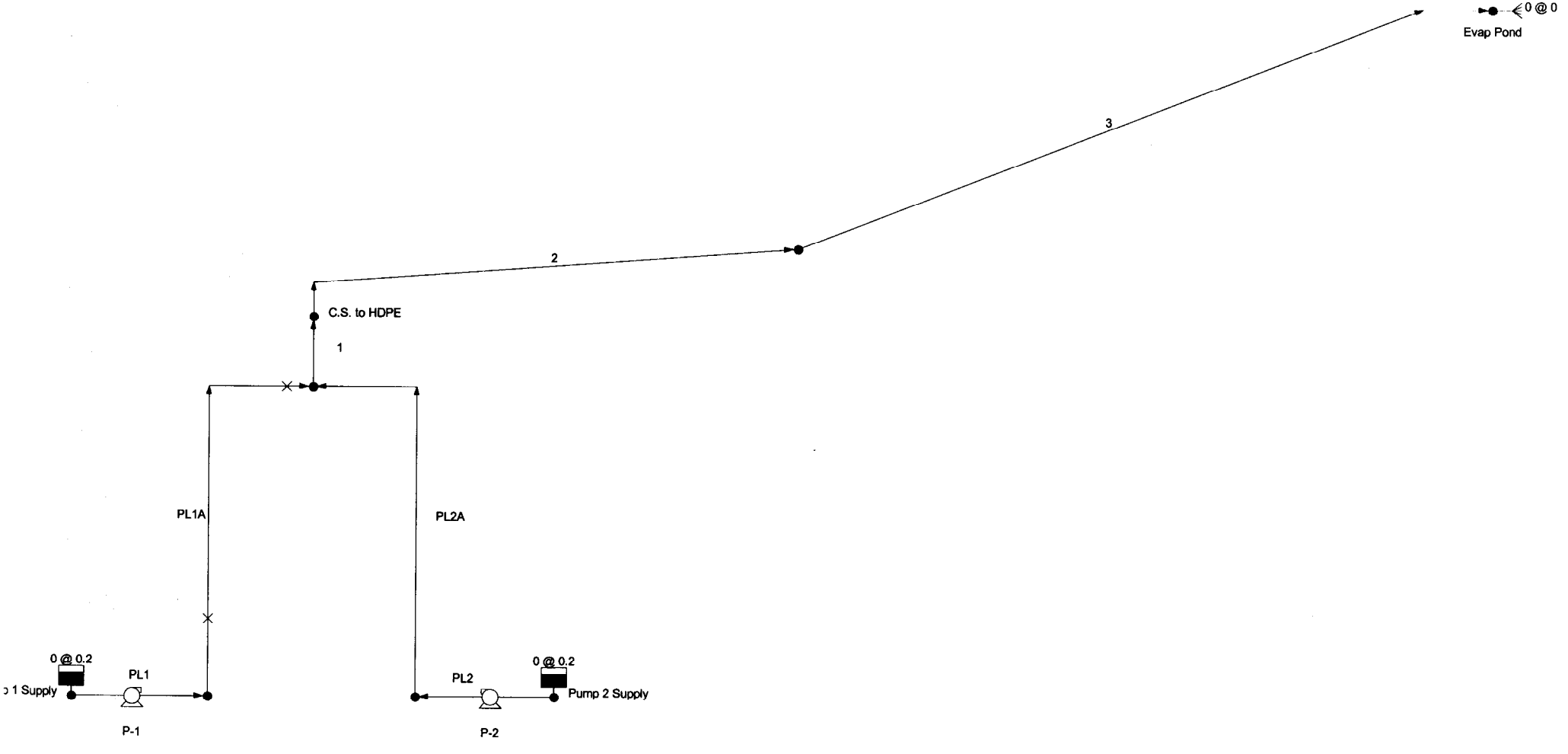
Flow US gpm	Speed rpm	Head ft	Pump %eff	Power bhp	NPSHr ft	Motor %eff	Motor kW	Hrs/yr	Cost /kWh
30	3450	37	---	---	---				
25	3450	40.1	---	---	---				
20	3450	42.3	---	---	---				
15	3450	44.2	---	---	---				
10	3450	46.1	---	---	---				



L1/6

SSSTF De-Con Water Pumps (sump to pond)	HYDROMATIC	GRINDER - 3600
Clint Kingsford	Catalog: GRIND60.MPC, vers .1	Size: G1LX200
04/18/01	Curve:	Speed: 3450 rpm
Selection file: SSSTFPMP.UFS	Design Point: 25 US gpm, 36 ft	Impeller: 4.12 L

PUMP FLO



PIPE CONFIGURATION
PUMPS TO POND

L1/01

Company:	INEEL	**System:**	SSSTFSMP
Project:	SSSTF	**Lineup:**	SSSTFSMP
by:	Clint Kingsford		
Comments:	Decon water (sump to pond)	**flow rate:**	US gpm
		pressure:	psi_g
Version:	PIPE-FLO 6.08 07/05/01 4:01 pm	**level & grade:**	ft

PIPELIST REPORT

Created: 04/18/01 9:52 am
Design file:
Specs: 2

Pipes: 7
Nodes: 8
Pumps/Comps: 2

SSSTF Decon water (sump to pond)

SPECIFICATIONS

SPECIFICATION	PIPE MATERIAL Sch / Roughness	FLUID Temp / Pres	VALVE TABLE	DESIGN LIMITS Vel / Pres
01 HDPE rev: 04/18/01 9:53 am	Plexco Sch 100-psi 6e-005 in Size for: 8 ft/sec	Water 60 °F 0 psi g	Standard	0 / 10 ft/sec 0 / 100 psi g
02 Steel rev: 04/18/01 10:10 am	Steel Sch 80 0.0018 in Size for: 6 ft/sec	Water 60 °F 0 psi g	Standard	0 / 12 ft/sec 0 / 100 psi g

12/17

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
	02	Steel 2 in / 80	1	Water 60 °F / 0 psi g	1.158
2	01	Plexco 2 in / 100-psi	220	Water 60 °F / 0 psi g	0.3796
3	01	Plexco 2 in / 100-psi	850	Water 60 °F / 0 psi g	1.555
PL1	02	Steel 2 in / 80	1	Water 60 °F / 0 psi g	0.78
PL1A	02	Steel 2 in / 80	5	Water 60 °F / 0 psi g	13.28
PL2	02	Steel 2 in / 80	1	Water 60 °F / 0 psi g	0.78
PL2A	02	Steel 2 in / 80	5	Water 60 °F / 0 psi g	13.28

Company: INEEL
Project: SSSTF
by: Clint Kingsford

Created: 04/18/01 9:52 am
Design file:
Specs: 2

SYSTEM REPORT

07/05/01 4:02 pm
System: SSSTFSMP
rev: 07/05/01 4:00 pm

Pipes: 7
Nodes: 8
Pumps/Comps: 2

13/17

SSSTF Decon water (sump to pond)

SYSTEM NODES

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
~N--002	4911.3	PL1	PL1A
~N--003	4911.3	PL2	PL2A
~N--005	4915	PL1A PL2A	1
~N--007	4917.22	2	3
C.S. to HDPE	4915	1	2
Pump 1 Supply	4911.3		PL1
Pump 2 Supply	4911.3		PL2
Evap Pond	4933	3	

14/17

PIPELINE	SPEC	FROM_NODE	TO_NODE	PUMP/COMP
	02	~N--005	C.S. to HDPE	.
	01	C.S. to HDPE	~N--007	.
3	01	~N--007	Evap Pond	.
PL1	02	Pump 1 Supply	~N--002	P-1
PL1A	02	~N--002	~N--005	.
PL2	02	Pump 2 Supply	~N--003	P-2
PL2A	02	~N--003	~N--005	.

PUMP/COMP	PERFORMANCE DATA					
P-1	US gpm:	0	15.9	30.2	40.3	48
	ft:	49.8	43.9	36.9	25.9	9.11
	eqn:	49.8 - 0.05186 Q ^ 1.677				
	Selection: SSSTFPMP from Catalog: GRIND60 Pump: GRINDER G1LX200 at 3450 rpm					
P-2	US gpm:	0	15.9	30.2	40.3	48
	ft:	49.8	43.9	36.9	25.9	9.11
	eqn:	49.8 - 0.05186 Q ^ 1.677				
	Selection: SSSTFPMP from Catalog: GRIND60 Pump: GRINDER G1LX200 at 3450 rpm					

Company: INEEL
Project: SSSTF
by: Clint Kingsford

Created: 04/18/01 9:52 am
Design file:
Specs: 2

07/05/01 4:02 pm
System: SSSTFSMP
rev: 07/05/01 4:00 pm

Pipes: 7
Nodes: 8
Pumps/Comps: 2

MATERIALS REPORT

SSSTF Decon water (sump to pond)

PIPE MATERIALS LIST

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
1	02	Steel 2 in / 80	1	1-Tee Flow Thru Branch
2	01	Plexco 2 in / 100-psi	220	1-Elbow Short - r/d 1 @ 90°
3	01	Plexco 2 in / 100-psi	850	2-Elbow Short - r/d 1 @ 45° 1-Exit Projecting
PL1	02	Steel 2 in / 80	1	1-Entrance Inward
PL1A	02	Steel 2 in / 80	5	1-Lift Check Vertical 1-Elbow Short - r/d 1 @ 90° 1-Gate Plug Type 1-Tee Flow Thru Branch
[illegible]	02	Steel 2 in / 80	1	1-Entrance Inward
PL2A	02	Steel 2 in / 80	5	1-Lift Check Vertical 1-Elbow Short - r/d 1 @ 90° 1-Gate Plug Type 1-Tee Flow Thru Branch

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PIPE MATERIAL	SCHEDULE	SIZE	LENGTH
Plexco	100-psi	2 in	1070 ft
Steel	80	2 in	13 ft

TOTAL SYSTEM VOLUME: 190.5 gallons

VALVE & FITTING SUMMARY

SPECIFICATION	MATERIAL	SCHEDULE	VALVES & FITTINGS
01 HDPE	Plexco	100-psi	
	Size: 2 in		1-Elbow Short - r/d 1 @ 90°
			2-Elbow Short - r/d 1 @ 45°
			1-Exit Projecting
02 Steel	Steel	80	
	Size: 2 in		3-Tee Flow Thru Branch
			2-Entrance Inward
			2-Lift Check Vertical
			2-Elbow Short - r/d 1 @ 90°
			2-Gate Plug Type